Original Article

Comparative advantage as a success factor in football clubs: Evidence from the English Premier League (EPL)

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ABSTRACT

As in international trade, football clubs can benefit more if they specialize in what they have or can create comparative advantage. In a world of scarce resources, clubs need to identify what makes them successful and invest accordingly. The main objective of this study is to understand what influences the success of football teams in the English Premier League (EPL) championship games. Based on Ricardo's model of comparative advantage and applying Factor analysis as well as Panel data approach, this study investigates the need for specialization and tradeoffs between defensive and offensive patterns of the game in order for EPL clubs to be more successful. The data used in this study covers the period 2010-2017 of the EPL data. The results reveal that, in general, a better defense is slightly more important for success. The outcomes were different for the top- and bottom-ranking clubs. We found that it is more important for bottom-ranking teams to play better defensively than offensively, while for top-performing teams, the probability of success is more affected by offensive style. In addition, there is a tradeoff between these two styles of play; when bottom-ranking teams try to play better defensively, it often comes at the expense of a poor offensive pattern, but almost no one plays offense at the expense of a poor defense. Unlike the bottom-ranking teams, the top-ranking teams did not face tradeoffs, but they were able to improve both their defensive and offensive patterns. The recommendation put forward by this study argue that bottom-ranking clubs should specialize first in defense. **Keywords:** MATCH ANALYSIS, TACTICS, OFFENSIVE, DEFENSIVE, SUCCESS

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FACTORS, PERFORMANCE INDICATORS, FACTOR ANALYSIS, COMPARATIVE ADVANTAGE, ENGLISH PREMIER LEAGUE.

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INTRODUCTION

Club success in sports is a relative term. While some teams are always trying to win the EPL, others are happy with just staying in the competition. Before every season starts, sport experts analyze potential overachievers and underachievers, based on money spent, squad experience, and other quantitative and qualitative perceptions.

As in international trade, football clubs can benefit more if they specialize in what they have or can create comparative advantage. In a world of scarce resources, clubs need to identify what makes them successful and invest accordingly; in playing better defensively and/or offensively, in selecting players carefully, in using smart management approaches, and so forth. We should keep in mind that having a comparative advantage does not necessary lead to success, despite an abundance of resources; also, not everyone needs to specialize in one direction, just as rich countries do not specialize in a few products. However, smaller clubs, like smaller countries, need to make maximum use of the resources they have.

The purpose of this study is to discover the best strategies for clubs with different rankings to increase their probability of success. By using quantitative methods, clubs can look at ways to create advantages in order to increase that probability. Every season in every sport involves overachievers and underachievers. The factors examined by the experts are plentiful – experience, squad chemistry, imbalanced squads, lack of defense, and lack of offense – in short, anything you can quantify. We limit ourselves here to analyses of how offensive and defensive play patterns affect the probability of success and explore what tradeoffs are called for (if any) between these two strategies.

The rest of the paper is organized as follows: the next section reviews the theoretical framework of the issue followed by relevant literature. Furthermore, section four describes the data and the econometric model. Section five reports the main empirical results. Finally, last section of the article summarizes the main findings and draws the conclusion.

Theoretical framework

Based on Ricardo's comparative advantage model, the abilities possessed by different teams may lead to comparative advantage in some parts of the game. As in international trade, all football clubs do not have the same characteristics. As some countries can produce cars and have a comparative advantage in car production, others offer a comparative advantage in oil production. Some countries have a comparative advantage in fruit or vegetable production. (Alvarez & Fuentes, 2012). The theory of comparative advantage has significant explanatory power and an impact on today's international trade (Costinot & Donaldson, 2012).

Football clubs need to create advantage and to be more successful than their opponents. However, as mentioned previously, all football clubs do not have the same goals, nor the same resources. Based on the resources that they do possess, they need to be able to achieve their goals. Applying the theory of comparative advantage to football reveals the potential of a tradeoff between offensive and defensive play that can help a club be more successful. Clubs that specialize in one pattern of play, either defensive or offensive (depends on their aspirations), are more successful than similar clubs that try to play better defensively and offensively at the same time.

In an attempt to explain what makes a country more successful in trade, most Economists, instead of analyzing only comparative advantage, focus on a narrower application of Ricardo's theory and analyse international trade relations through revealed comparative advantage (RCA) (Balassa, 1965; Laursen, 2015;Brakman & Van Marrewijk, 2017). While larger countries need less specialization due to their greater resources, specialization, according to the theory of comparative advantage, still benefits a country by pushing it to use its resources, and to produce and trade, in accordance with its comparative advantage (Gallardo, 2005; Acharya, 2008).

The EPL was created on the back of the old First Division in 1992. It is the largest football league, and offers the largest numbers of rich football clubs, in terms of revenue, in Europe. The financial success of the league and its clubs depends on several factors, such as field success, brand value, and team investments (Rohde & Breuer, 2016; Carmichael, McHale, & Thomas, 2011). With the influx of foreign direct investment and changes in ownership within the EPL, clubs are able to afford better players, which leads to richer and better teams, with strong financing and higher positions in the league. As a result, however, the competitive balance of the league has been reduced (Jones & Cook, 2015), but one of the biggest fears, that increased spending might cause a financial crisis, has so far been unfounded (Szymanski, 2010; Georgievski & Zeger, 2016). In order for clubs to be more successful, they need to spend more, but increased spending and increased income in the league, have led to an increase in the price of assets (players), and this had led to the fear of a financial crisis. Moreover, key promoters of this increased spending on transfers and players have increased the income in football from TV rights (Burdekin & Franklin, 2012); income for domestic TV rights was £5.14 billion in 2018.

Football is becoming the most televised sport on the globe. The amount of money paid for TV broadcasting rights points to the future development of the game (Buraimo, Paramio, & Campos, 2010). English football clubs are reaping the highest income from selling the league's game rights around the world. What is even more interesting is that increased uncertainty of match outcome, increases revenue of the clubs. The more balance a league has and the more uncertain game outcomes are, the more demand there is for broadcasts across the entire league. Fans and consumers prefer watching uncertain games on TV (Buraimo & Simmons, 2008; Cox, 2018).

Since the nature of competition means teams must try to outscore their opponents, and at the end of year collect more points, football clubs have been trying to develop ways and plays to win. Since the game consists of both offensive and defensive play, this article focuses on the specialization of teams in regard to these styles of play, in light of Ricardo's Theory of Comparative Advantage.

Just as countries can have certain advantages in international trade, football clubs can achieve a comparative advantage involving certain aspects of the game, such as details of defensive and offensive play, and elements such as possession, set-piece scoring, and counter-attack plays.

Sports writers talk of achieving competitive advantage in sports, some look at different aspects of the game as a model for creating comparative rather than competitive advantage. Berman et al. (2002) analyzed tacit knowledge as way of creating competitive advantage in the NBA. They found that there is a positive relationship between shared team experience and team performance, indicating that playing together for a period of time can create an advantage for clubs.

One of the first studies in this area was conducted by Tcha and Pershin (2003), who observed that countries may specialize in sports the way they specialize in international trade, by creating comparative advantage in a specific sports. Additionally, these authors used the concept of revealed comparative advantage (RCA) to examine the Olympic Games, analyzing both specialization in sports and the RCA concept, and found that high-income countries specialize less.

Bois and Heyndels (2012) had very interesting findings regarding influences on patterns of specialization. In their study, levels of success clearly relied on population and wealth. There was a tendency for high-income countries to diversify their activity more. Other factors that influenced comparative advantage were population size, politics, and religion. The results show that socialist countries have a significant RCA in non-running events, where talent detection and youth development programs are crucial, whereas they have a revealed disadvantage in sprinting.

Literature review

The application of economic theories to sports is not new. Many scholarly articles focus on the relationship between economics and sports, and the impact of economics on sports. However, very few articles analyze the use of comparative advantage in sports. Related articles on football address either the performance of football clubs or aspects of the game that lead to competitive advantage.

Fernandez-Navarro, Fradua, Ford, and McRobert (2016) used a methodology similar to the one used in this study to analyze the offensive and defensive styles of play of Spanish and English teams. Using factor analysis, they examined 19 performance indicators (14 offensive and 5 defensive), with the aim of categorizing the football teams. The authors concluded that teams could be differentiated by their playing styles, based on specific performance indicators, which can be used to compare teams in competition and can also be used by teams to design specific training to improve their profiles.

In an attempt to analyze the keys to success of EPL teams, Oberstone (2009) analyzed performance in 2007-2008 years. He used analysis of variance (ANOVA) to separate the teams into three different categories (top, bottom, and middle of the league) and then used a retrodictive linear multiple regression model that defined five pitch factors (defending, crosses, goal attempts, discipline, passing) that contributed to success and more points scored by a football club.

A similar approach, but one that focused on the European Champions League was used by Liu, Yi, Giménez, Gómez, & Lago-Peñas (2015). It involved 16 performance-related items and clustered teams based on their strength.

Among the most frequently analyzed aspects of sports competition are the home advantage and the significance of playing in front of a home crowd (Carmichael & Thomas, 2005; Lago-Peñas & Lago-Ballesteros, 2011). The home advantage is created by a number of factors (Legaz-Arrese, Moliner-Urdiales, & Munguía-Izquierdo, 2013): crowd familiarity, travel, rules, and territoriality. Leite (2017) analyzed 3,223 games in ten football leagues in Europe for the 2015-2016 season. Marek and Vávra (2017) analyzed the EPL teams from the 1992-1993 season to the 2015-2016 season. Their study used a goal-difference approach rather than a points-scored approach to show home advantage. In addition, Ribeiro, Mukherjee, and Zeng (2016) performed an analysis of home game advantage in the NBA. They analyzed in-game changes and the effects of the home advantage, and concluded that home teams score an added 0.13 points per minute in home matches.

Szimanski and Kuper (2009), in his book *Soccernomics* looked at racism issues in mid-1990s football in England. In his book, used regression analysis to investigate the impact of black players on football clubs. He found by comparing clubs with similar budgets, that clubs which were more willing to use black—namely, lower-priced—players held better positions.

When comparative advantage is seen as a form of specialization intended to lower the cost of production, or in this case, to lead to team success, the use of lower-priced players leads to comparative advantage. Thus, in a similar way, the current EPL is exploring other leagues to find cheaper players.

One of the most frequent objects of analysis in the area of competitive sports is performance. Araya and Larkin (2014) analyzed the performance of English teams in 2012-2013 and found that the factor that distinguished the top ten from the bottom ten teams was possession. In order to control a football game, a team needs to have more frequent possession of the ball. Similar findings, but for different leagues, can be found from other studies (Lago-Peñas & Dellal , 2010; Armatas, Zaggelidis, Skoufas, Papadopoulou, & Fragkos, 2009; GÖRAL, 2015; Kempe, Vogelbein, Memmert, & Nopp, 2014; Aquino, Garganta, Manechini, Bedo, & Puggina, 2017). Moreover, for possession to be effective, it must happen closer to your opponent's goal; otherwise, an increase in possession is totally ineffective (Casal, Maneiro, Ardá, Marí, & Losada, 2017).

Using an Elo rating system, Gasquez and Royuela (2014) performed a sensitivity analysis and concluded that economics, demographics, weather, geography, and football institutions are factors in success. Additionally, they showed that this ranking based on these factors are better indicators of success than FIFA rankings.

Studies of performance often focus on parts of the game such as manager changes and their impact (Gonzalez-Gomez, Picazo-Tadeo, & Garcia-Rubio, 2011) or the impact of ownership structure on team performance (Wilson, Plumley, & Ramchandani, 2013; Flint , Plumley, & Wilson, 2015; Besters, Van Ours, & Van Tuijl, 2016). While clubs can improve their performance with a mid-season manager change, they are not as efficient as clubs that do not change managers. Additionally, clubs that are on the stock market perform better and comply more with FIFA financial fair play rules.

Bois and Heyndels (2012) followed the same approach in exploring specialization and comparative advantage in athletics. They found that richer countries diversify more, larger countries specialize in sprinting and middle-distance running, and (former) socialist countries have a significant revealed comparative advantage in non-running events and a disadvantage in sprinting. The date used and the empirical methodology employed are discussed next.

DATA AND METHODOLOGY

The main objective of this study was to discover factors that influence the success of football teams in EPL championship games. Each team observed was categorized according to its offensive and defensive play patterns, using factor analysis. A total of 12 performance indicators were analyzed; six represented the offensive and six the defensive style of play. Teams were ranked from 1 (the least successful) to 20 (the most successful) based on points scored. Teams ranking 15th or above were defined as successful, teams ranking sixth or below as unsuccessful. The analyses include 2010-2017 EPL championship panel data obtained online from www.whoscored.com. Variables used in empirical analysis can be summarized in Table 1 with the respective notations.

Table 1. Variables and respective notations

Variable	Notation
Points during the season	**Pts**
Annual wage budget	**Salaries**
Total conceded goals during the season	**GA**

Average number of shots allowed per game during the season	**Shots allowed pg**
Average number of tackles per game during the season	**Tackles pg**
Average number of interceptions per game during the season	**Interceptions pg**
Average number of fouls per game during the season	**Fouls pg**
Average number of off-sides per game during the season	**Offsides pg**
Total scored goals during the season	**GF**
Average number of shots per game during the season	**Shots pg**
Average number of shots on target per game during the season	**Shots OT pg**
Average number of dribbles per game during the season	**Dribbles pg**
Average number of times a team was fouled in a game	**Fouled pg**

Using factor analysis, we defined two patterns for each team in each season – how offensive and how defensive they are. To understand the offensive patterns, we use following variables: *Conceded Goals*, *Shots allowed per game*, *Tackles per game*, *Interceptions per game*, *Fouls per game, Off-sides per game*. To assess defensiveness, we use the following variables: *Scored goals*, *Shots per game*, *Shots on target per game*, *Dribbles per game*, *Fouled per game* (see table 1). As a dependent variable, we generate *success*, which takes a value of 0 if a team's rank is less than or equal to 6, a value of 2 if a team's rank is 15 or above, and a value of 1 otherwise. The rank of a team is based on total points scored. Teams with the same score have the same rank. Thus, the number of teams in the different categories varies, as shown in Table 2. Finally, we apply regression analysis with different modifications to identify factors that affect the success of a football team in the EPL.

Table 2. Number of teams by success category, 2010-2017

Years	**Success**			**Total**
	0	**1**	**2**	
2010	6	8	6	20
2011	6	8	6	20
2012	6	8	6	20
2013	7	7	6	20
2014	5	9	6	20
2015	6	8	6	20
2016	6	8	6	20
2017	5	9	6	20

EMPIRICAL RESULTS AND DISCUSSION

Defining defensive patterns

Appendix A presents the results of the factor analysis of defensive patterns. *Factor* retained only the first three factors because the eigenvalues associated with the remaining factors were negative. According to the default mineigen (0) criterion, a factor must have an eigenvalue greater than zero to be retained. Although *factor* elected to retain three factors, only the first one appears to be meaningful.

The first variable (*ga*) seems to be the most important for describing the defensive pattern of a team because it affects all the other variables "positively" (coefficient = 0.7755), as shown by the signs in the first column of the factor-loading table. The signs on three of the loadings are negative, while these variables have reversed their influence. In other words, higher number of goals allowed (*ga*), shots allowed per game (*shotsallowedpg*), and fouls per game (*foulspg*) are associated with poor defensive patterns, whereas a higher number of tackles per game (*tacklespg*), interceptions per game (*interceptionspg*), and off-sides per game (*offsiderspg*) are associated with good defensive patterns. Most of the uniqueness coefficients are not high, which means that the variables are explained well by the factors. From the factor analysis, we save fitted values under a new variable called *defensive*, with a reversed sign, so that a low value means a weak defensive pattern, and a high value a strong one.

The variable *defensive* varies within a -1.8 to 1.8 interval. In general, looking at linear trends on Figure 1, we observe that the top and bottom teams have positive trends, but improvement in defensiveness is more pronounced top ranked teams in recent years. The gap between the most successful (= 2) and the least successful (= 0) teams reached its maximum in 2017.

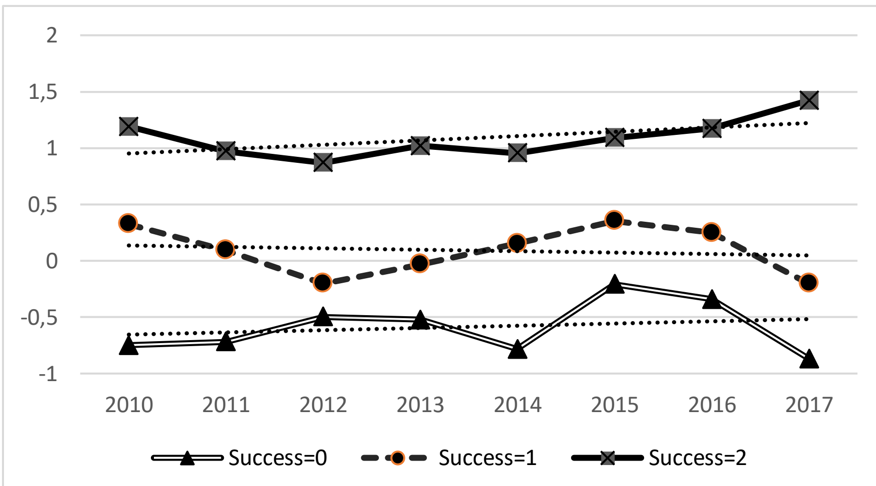

Figure 1. Average defensiveness of teams by success category, 2010-2017

Defining offensive patterns

As can be seen from *Appendix B*, factor analysis was performed to identify the offensive patterns of teams. Even though the analysis retained the first three factors, only the first factor appears to be meaningful (with an eigenvalue of 2.88).

The first three variables (*gf*, *shotspg*, *shotsotpg*) seem to be the most important for describing the offensive patterns of a team. The other two variables (*dribblespg*, *fouledpg*) also have a positive influence, but it is rather weak. This is reflected in the high uniqueness coefficients. Higher numbers for all the variables are associated with more offensive patterns. The fitted values of the factor analyses we define as "offensive" coefficients for each team.

The variable *offensive* varies within a -2 to 2.6 interval. On average offensive pattern has downward sloping trend, meaning that teams played less offensively over time on average. The gap between the most successful (= 2) and the least successful teams (= 0) reached its maximum in 2017 due to outstanding offensive pattern among top ranked teams (Figure 2).

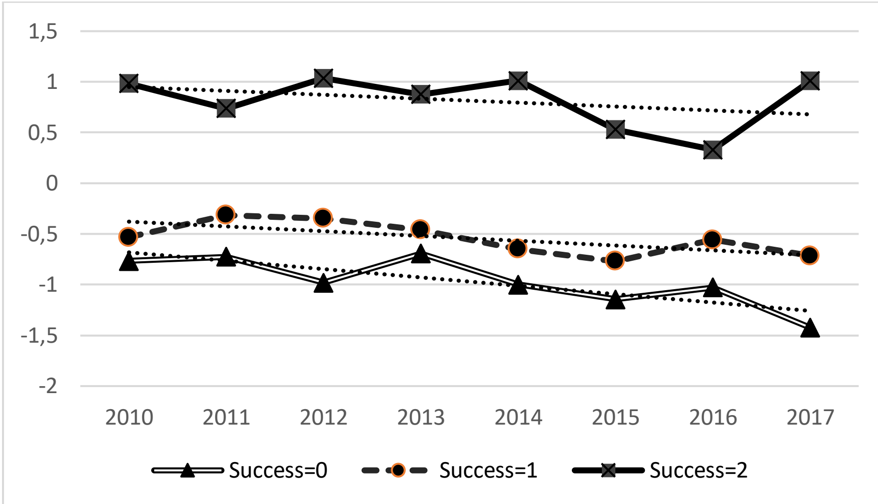

Figure 2. Average offensiveness of teams by success category, 2010-2017

Regression analysis

In order to understand how the offensive and defensive strategies of a team affect its success, we apply the Tobit model as well as the OLS model. Panel-level variance is negligible and not different from the pooled one, as shown by the *rho* coefficient (*see Appendix C*). Both models give robust results, and coefficients of both variables are significant and similar (Table 3). A strong defense increases one's chances of success more than a strong offense. Our findings prove one of the oldest aphorisms in sports, one that applies especially to football: "Defense wins championships".

Table 3. Tobit & Ordinary Least Square (OLS) results

		Tobit Model		OLS Model	
Dependent variable	Independent variables	Coefficient (Std. Error)	Z-stat (P-value)	Coefficient (Std. Error)	T-stat (P-value)
Success	Offensive	0.3256***	5.57	0.3319***	6.01
		(0.0584)	(0.000)	(0.0553)	(0.000)
	Defensive	0.4192***	6.58	0.4394***	7.23
		(0.0637)	(0.000)	(0.0608)	(0.000)

****, **, and * denotes statistical significance level at 1%, 5%, and 10%, respectively.*
For more information, see Appendix C and D.

Even if we standardize the independent variables used in the models to control for small discrepancies, *defensive* still appears to have a stronger impact on *success*, than *offensive* as seen in Table 4.

Table 4. Tobit & Ordinary Least Square (OLS) results

		Tobit Model		**OLS Model**	
Dependent variable	Independent variables	Coefficient (Std. Error)	Z-stat (P-value)	Coefficient (Std. Error)	T-stat (P-value)
Success	zOffensive	0.3018*** (0.0541)	5.57 (0.000)	0.3077*** (0.0512)	6.01 (0.000)
	zDefensive	0.3533*** (0.0537)	6.58 (0.000)	0.3703*** (0.0512)	7.23 (0.000)

Source: Authors' computation by using the following formula: z = (x-μ)/σ.
Standardized variables have a mean equal to 0 and a standard deviation equal to 1.
****, **, and * denotes statistical significance level at 1%, 5%, and 10%, respectively.*
For more information, see Appendix E and F.

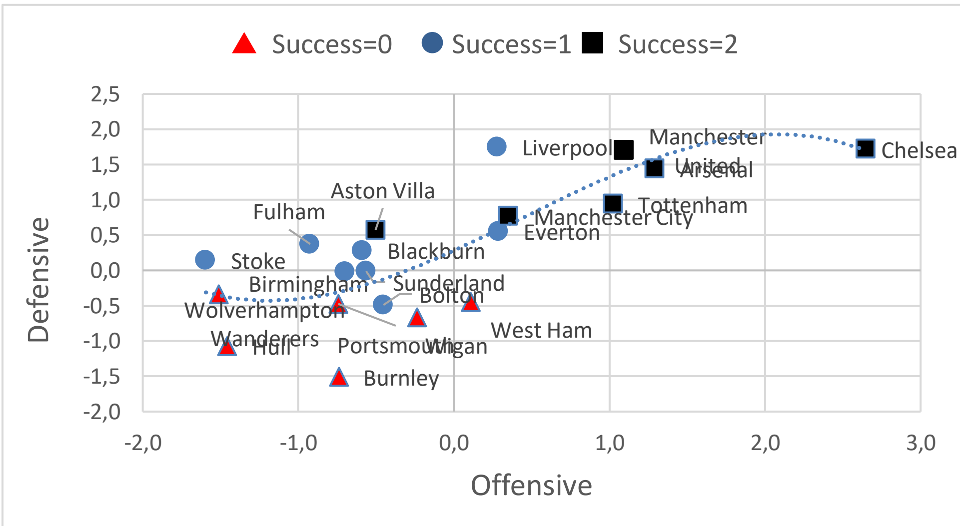

Figure 3. Offensive and defensive coefficients by success category, 2010

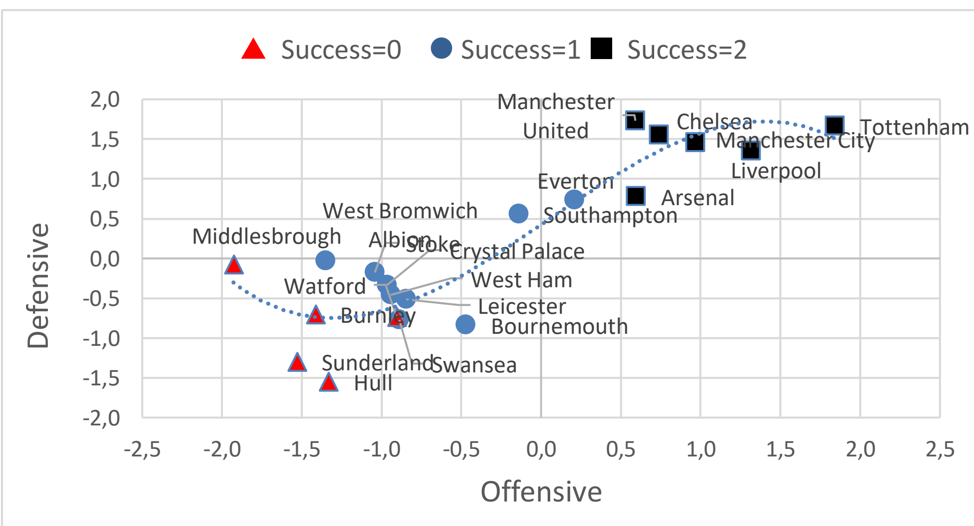

Figure 4. Offensive and defensive coefficients by success category, 2017

Note: See Appendix I for graphs of all the other years.

The Figures 3 and 4 show that better-performing teams can improve in both defensive and offensive play (that is, move away from the lower left in the graph toward the upper right), but there is a tradeoff for bottom-ranking teams: If a team concentrates on playing better defensively, it might weaken its offense. In addition, in general, these teams play better defensively than offensively (upper left quadrant), but almost none of them plays offensively at the expense of a poor defense (the lower right quadrant is usually empty[1]). The correlation between degrees of offensive and defensive play differs significantly between the top- and bottom-ranking teams,[2] indicating that the tradeoff between these two strategies is weaker among the better teams, which manage to improve simultaneously in both. We split our regression analysis into two parts to see which strategy is more important for a team to move from success category 0 to 1 and separately from 1 to 2. In Table 5, the column "Success 0-1" includes teams from the bottom- (0) and mid-ranking (1) categories, whereas the column "Success 1-2" includes teams from the mid- (1) and top-ranking (2) categories.

Table 5. The importance of offensive vs. defensive strategies for different success categories

		Success 0-1			
		Tobit Model		**OLS Model**	
Dependent variable	Independent variables	Coefficient (Std. Error)	Z-stat (P-value)	Coefficient (Std. Error)	T-stat (P-value)
Success	Offensive	0.2208***	2.65	0.1752***	2.23
		(0.0832)	(0.008)	(0.0785)	(0.028)
	Defensive	0.2762***	4.24	0.2994***	4.60
		(0.0651)	(0.000)	(0.0650)	(0.000)
		Success 1-2			
		Tobit Model		**OLS Model**	
Dependent variable	Independent variables	Coefficient (Std. Error)	Z-stat (P-value)	Coefficient (Std. Error)	T-stat (P-value)
Success	Offensive	0.2381***	4.62	0.2712***	5.86
		(0.0516)	(0.000)	(0.0463)	(0.000)
	Defensive	0.2136***	3.55	0.2277***	3.86
		(0.0601)	(0.000)	(0.0590)	(0.000)

****, **, and * denotes statistical significance level at 1%, 5%, and 10%, respectively.*
For more information, see Appendix G and H.

As can be seen from Table 5, the probability of success for the teams in the "Success 0-1" category is influenced more by their defensive strategy, while for teams that want to shift from the middle category to the top category, offense plays a greater role. The results are robust for all of the models, and all of the coefficients are statistically significant.

We have also included the annual budgets for salaries in the analyses (not reported). For the subgroup "Success 0-1," the variable was not significant and the coefficient was almost zero, while for subgroup "Success 1-2," the variable had a positive coefficient and was statistically significant, with a *p*-value of 0.014. These results indicate that among the mid- and top-ranking teams, the richer teams have a better chance of becoming more successful compared to the similar teams, in terms of offensive and defensive patterns.

[1] See Appendix I.
[2] The correlation is 0.48 for the top-ranking teams and 0.02 for the bottom-ranking ones.

CONCLUSION AND RECOMMENDATIONS

Success in football depends on many interrelated aspects – finances, talent selection, management approaches, training, etc., and while resources are limited, teams need to make optimal decisions about how to allocate their resources to increase their chances of success: Should they specialize and gain a comparative advantage through their defensive or offensive style. This is the main question addressed in this paper.

We found that top-ranking football clubs have less need for specialization; they can improve in both offense and defense. Both modes of play increase the probability of success, but for the "good"[3] clubs, it is more effective to play better offensive. Low-ranking clubs face tradeoffs between these two styles of play – for them, better defensive play often comes at the expense of offense.

As a result, we argue that bottom-ranking clubs should specialize first in defense. The research also shows that financial resources have a weak but significant influence on the probability of success for "good" clubs, while they are totally insignificant for bottom-ranking clubs.

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APPENDICES

Appendix A: Output of the factor analysis defining defensive patterns

```
. factor ga shotsallowedpg tacklespg interceptionspg foulspg offsidespg [aweight = ga], factors(1)
(sum of wgt is   8.3620e+03)
(obs=160)

Factor analysis/correlation                     Number of obs    =        160
    Method: principal factors                   Retained factors =          1
    Rotation: (unrotated)                       Number of params =          6
```

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	1.22803	0.25542	0.6937	0.6937
Factor2	0.97261	0.83304	0.5494	1.2431
Factor3	0.13957	0.21963	0.0788	1.3219
Factor4	-0.08006	0.13743	-0.0452	1.2767
Factor5	-0.21748	0.05490	-0.1229	1.1539
Factor6	-0.27238	.	-0.1539	1.0000

```
    LR test: independent vs. saturated:  chi2(15) =  179.12 Prob>chi2 = 0.0000

Factor loadings (pattern matrix) and unique variances
```

Variable	Factor1	Uniqueness
ga	0.7755	0.3986
shotsallow~g	0.7250	0.4743
tacklespg	-0.2686	0.9278
intercepti~g	-0.0642	0.9959
foulspg	0.0129	0.9998
offsidespg	-0.1564	0.9755

Appendix B: Output of the factor analysis defining offensive patterns

```
. factor gf shotspg shotsotpg dribblespg fouledpg [aweight = gf], factors(1)
(sum of wgt is   8.3620e+03)
(obs=160)

Factor analysis/correlation                    Number of obs    =        160
    Method: principal factors                  Retained factors =          1
    Rotation: (unrotated)                      Number of params =          5
```

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	2.88498	2.73819	0.9818	0.9818
Factor2	0.14680	0.12592	0.0500	1.0317
Factor3	0.02088	0.07093	0.0071	1.0388
Factor4	-0.05005	0.01397	-0.0170	1.0218
Factor5	-0.06402	.	-0.0218	1.0000

```
    LR test: independent vs. saturated:  chi2(10) =  647.69 Prob>chi2 = 0.0000

Factor loadings (pattern matrix) and unique variances
```

Variable	Factor1	Uniqueness
gf	0.9025	0.1855
shotspg	0.9262	0.1421
shotsotpg	0.9834	0.0328
dribblespg	0.4886	0.7613
fouledpg	0.0820	0.9933

Appendix C: Tobit model results (xttobit, success, offensive, defensive)

success	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
offensive	.3255611	.0583973	5.57	0.000	.2111045	.4400177
defensive	.419168	.0636954	6.58	0.000	.2943274	.5440086
_cons	.9959555	.0500781	19.89	0.000	.8978042	1.094107
/sigma_u	.1362694	.0637591	2.14	0.033	.0113038	.2612349
/sigma_e	.4299319	.0275895	15.58	0.000	.3758574	.4840064
rho	.0912899	.0823009			.0102861	.3631825

```
         0  left-censored observations
       160     uncensored observations
         0 right-censored observations
```


Appendix D: OLS model results (xttobit, success, offensive, defensive)

```
. reg success offensive defensive
```

Source	SS	df	MS
Model	62.6394019	2	31.319701
Residual	32.3543481	157	.20607865
Total	94.99375	159	.597444969

Number of obs	=	160
F(2, 157)	=	151.98
Prob > F	=	0.0000
R-squared	=	0.6594
Adj R-squared	=	0.6551
Root MSE	=	.45396

success	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
offensive	.3318847	.0552644	6.01	0.000	.222727	.4410423
defensive	.4394354	.060786	7.23	0.000	.3193715	.5594992
_cons	1.006981	.0432527	23.28	0.000	.921549	1.092413

Appendix E: Tobit model results (xttobit, success, zoffensive, zdefensive)

success	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
zoffensive	.3018002	.0541352	5.57	0.000	.1956972	.4079032
zdefensive	.3532784	.053683	6.58	0.000	.2480617	.4584951
_cons	.9929337	.0442279	22.45	0.000	.9062485	1.079619
/sigma_u	.1362694	.0637591	2.14	0.033	.0113038	.2612349
/sigma_e	.4299319	.0275895	15.58	0.000	.3758574	.4840064
rho	.0912899	.0823009			.0102861	.3631825

```
  0  left-censored observations
160     uncensored observations
  0 right-censored observations
```

Appendix F: OLS model results (xttobit, success, zoffensive, zdefensive)

```
. reg success zoffensive zdefensive
```

Source	SS	df	MS			
				Number of obs	=	160
				F(2, 157)	=	151.98
Model	62.6394018	2	31.3197009	Prob > F	=	0.0000
Residual	32.3543482	157	.206078651	R-squared	=	0.6594
				Adj R-squared	=	0.6551
Total	94.99375	159	.597444969	Root MSE	=	.45396

success	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
zoffensive	.3076622	.0512309	6.01	0.000	.2064714	.408853
zdefensive	.3703599	.0512309	7.23	0.000	.2691691	.4715507
_cons	1.00625	.0358886	28.04	0.000	.9353632	1.077137

Appendix G: Tobit model and OLS results (xttobit, success, offensive, defensive if success<=1)

success	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
offensive	.2207572	.0832343	2.65	0.008	.057621	.3838933
defensive	.2761986	.0651288	4.24	0.000	.1485484	.4038488
_cons	.7681594	.0764264	10.05	0.000	.6183663	.9179524
/sigma_u	.1910373	.052836	3.62	0.000	.0874807	.294594
/sigma_e	.3765459	.0287724	13.09	0.000	.320153	.4329388
rho	.2047052	.0994568			.0653184	.4450143

```
  0  left-censored observations
112     uncensored observations
  0 right-censored observations
```

```
. reg success offensive defensive if success<=1
```

Source	SS	df	MS			
				Number of obs	=	112
				F(2, 109)	=	20.14
Model	7.36071239	2	3.68035619	Prob > F	=	0.0000
Residual	19.9160733	109	.182716269	R-squared	=	0.2699
				Adj R-squared	=	0.2565
Total	27.2767857	111	.245736808	Root MSE	=	.42745

success	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
offensive	.1752335	.0784482	2.23	0.028	.0197516	.3307153
defensive	.2993693	.0650112	4.60	0.000	.1705192	.4282194
_cons	.762856	.0665061	11.47	0.000	.6310431	.8946689

Appendix H: Tobit model and OLS results (xttobit, success, offensive, defensive if success>=1)

success	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
offensive	.2380884	.0515784	4.62	0.000	.1369966	.3391801
defensive	.2135677	.0601303	3.55	0.000	.0957145	.3314208
_cons	1.298052	.0465722	27.87	0.000	1.206773	1.389332
/sigma_u	.1150844	.0426113	2.70	0.007	.0315676	.1986011
/sigma_e	.2921039	.0216811	13.47	0.000	.2496098	.334598
rho	.1343667	.092391			.0260257	.3938648

```
  0  left-censored observations
113     uncensored observations
  0 right-censored observations
```

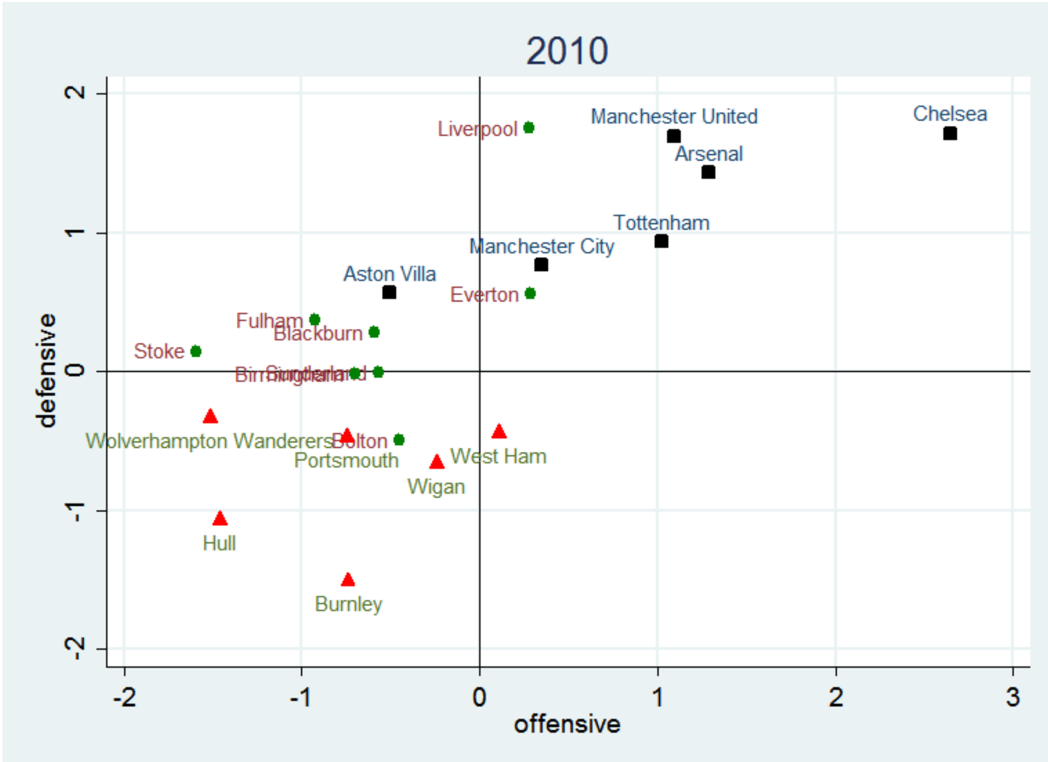
```
. reg success offensive defensive if success>=1
```

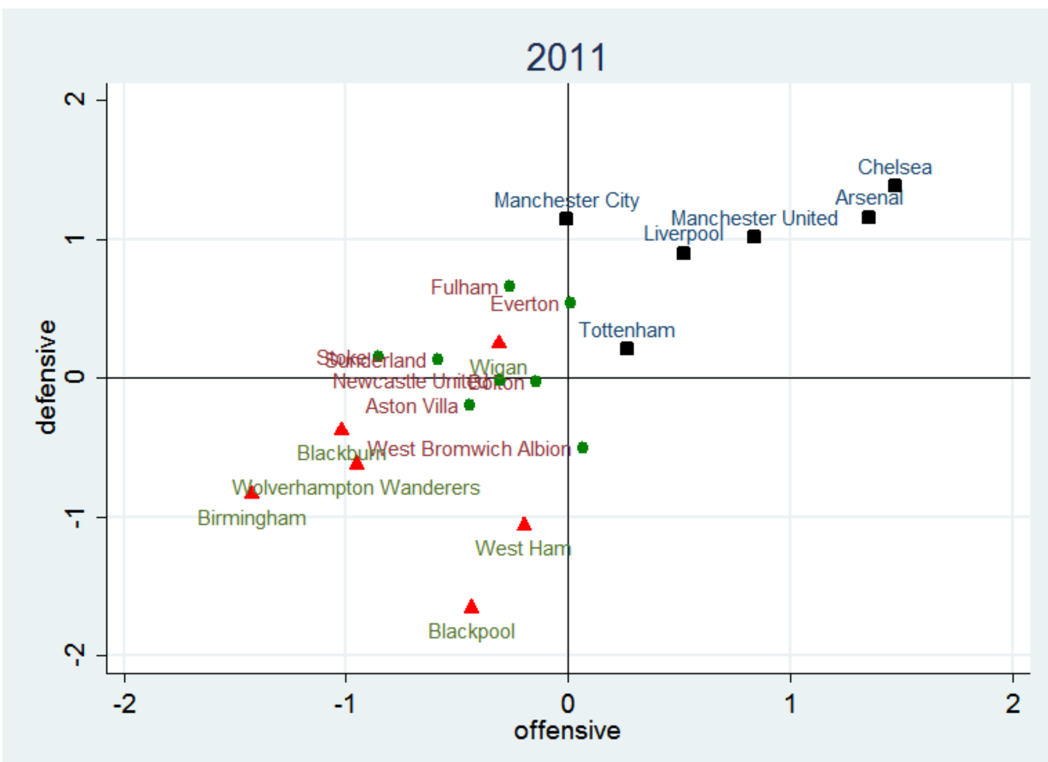
Source	SS	df	MS			
				Number of obs	=	113
				F(2, 110)	=	81.35
Model	16.4732488	2	8.23662442	Prob > F	=	0.0000
Residual	11.1373706	110	.101248824	R-squared	=	0.5966
				Adj R-squared	=	0.5893
Total	27.6106195	112	.246523388	Root MSE	=	.3182

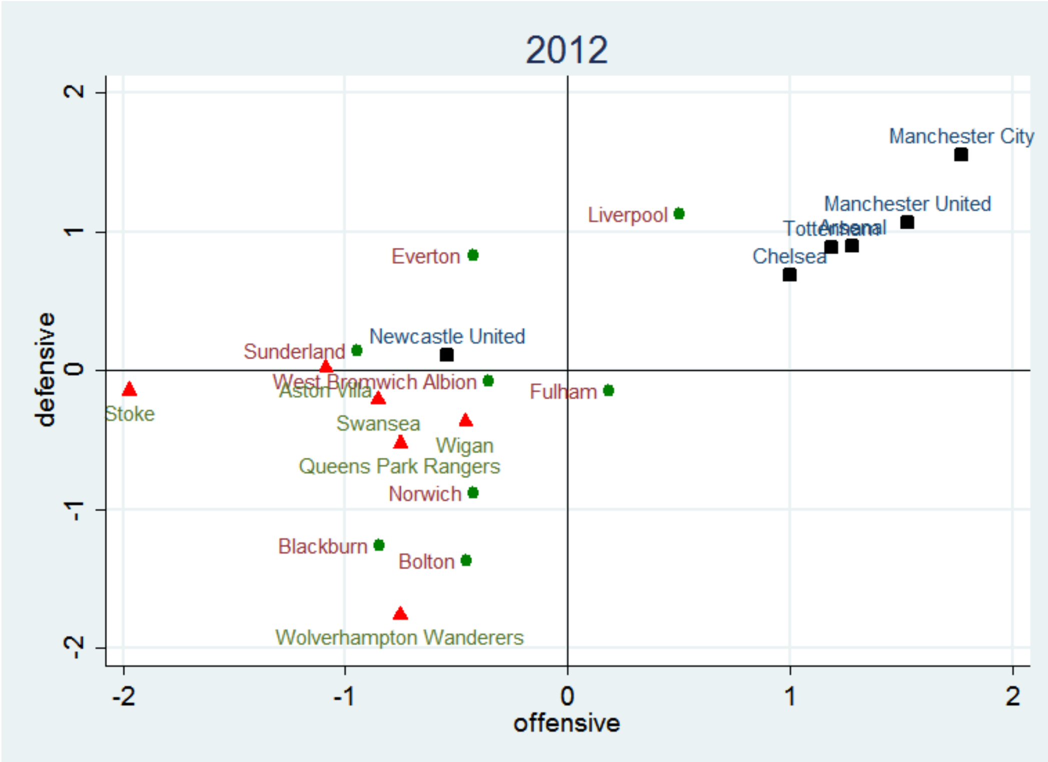
success	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
offensive	.271164	.0462979	5.86	0.000	.1794124	.3629155
defensive	.2276553	.0590312	3.86	0.000	.1106694	.3446412
_cons	1.299705	.0419028	31.02	0.000	1.216663	1.382746

Appendix I: Offensive and defensive play by success, 2010-2017

▲ **Success=0** ● **Success=1** ■ **Success=2**






2012
Manchester City
Manchester United
Tottenham
Arsenal
Chelsea
Liverpool
Everton
Newcastle United
Sunderland
West Bromwich Albion
Aston Villa
Fulham
Stoke
Swansea
Wigan
Queens Park Rangers
Norwich
Blackburn
Bolton
Wolverhampton Wanderers
defensive
offensive
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-1
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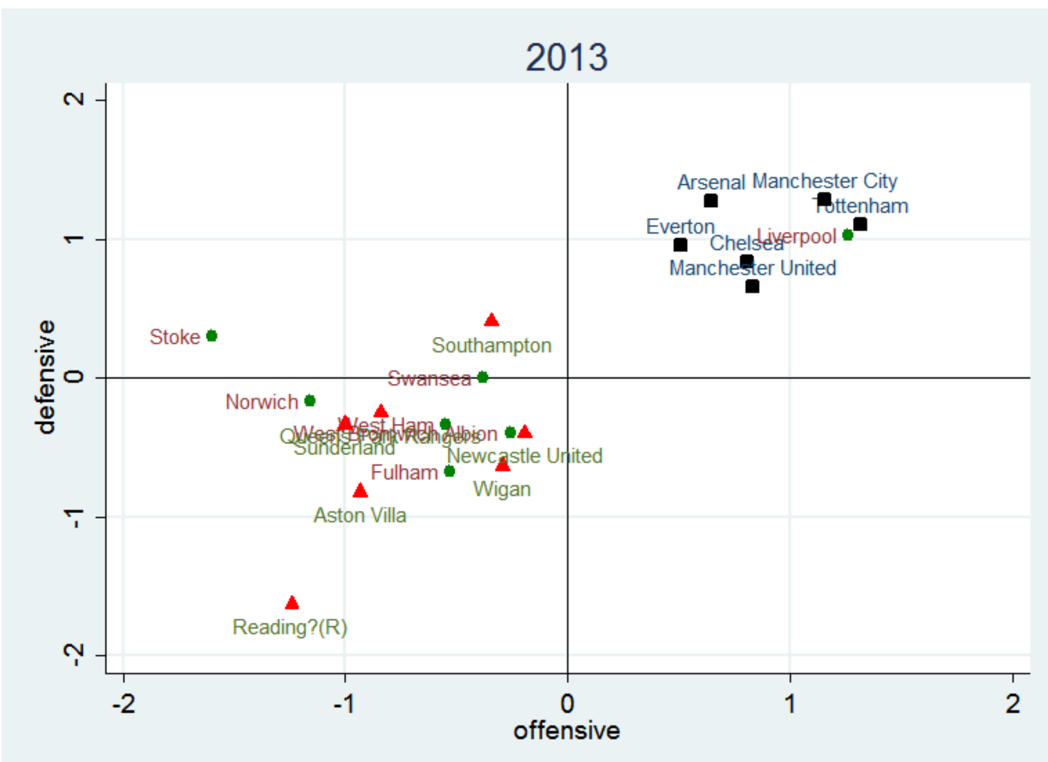
1
2


2013
Arsenal
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Liverpool
Manchester United
Stoke
Southampton
Swansea
Norwich
West Ham
West Bromwich Albion
Queens Park Rangers
Sunderland
Newcastle United
Fulham
Wigan
Aston Villa
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defensive
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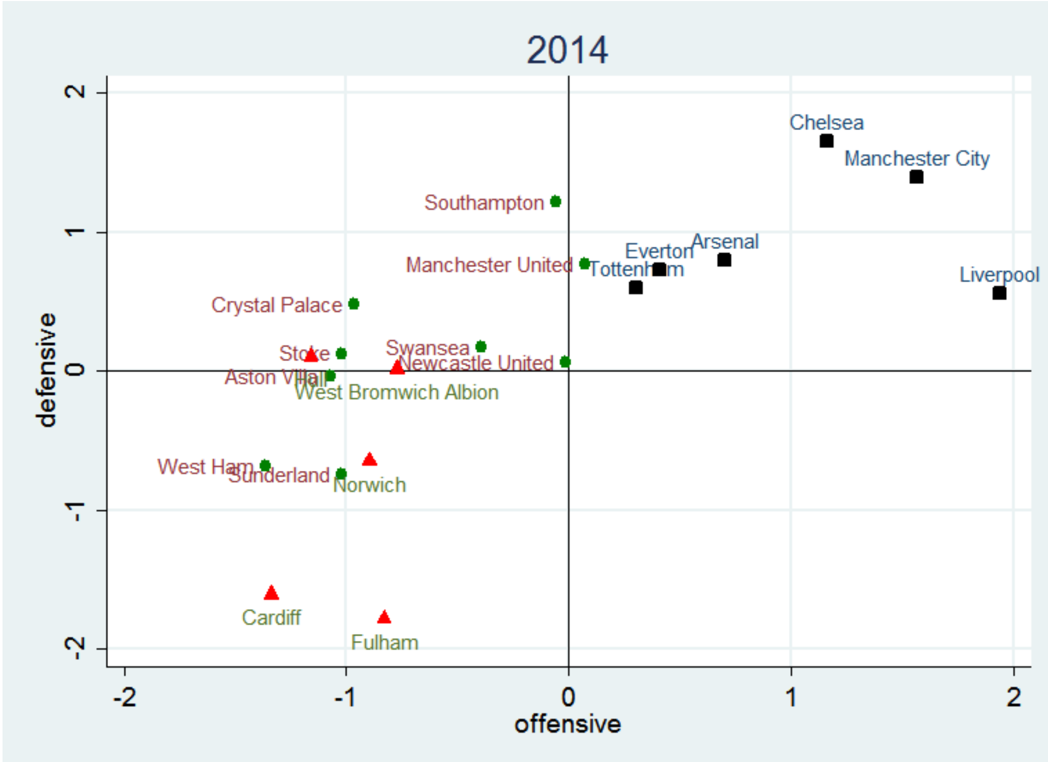
1
2


2014
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Crystal Palace
Stoke
Swansea
Newcastle United
Aston Villa
Hull
West Bromwich Albion
West Ham
Sunderland
Norwich
Cardiff
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defensive
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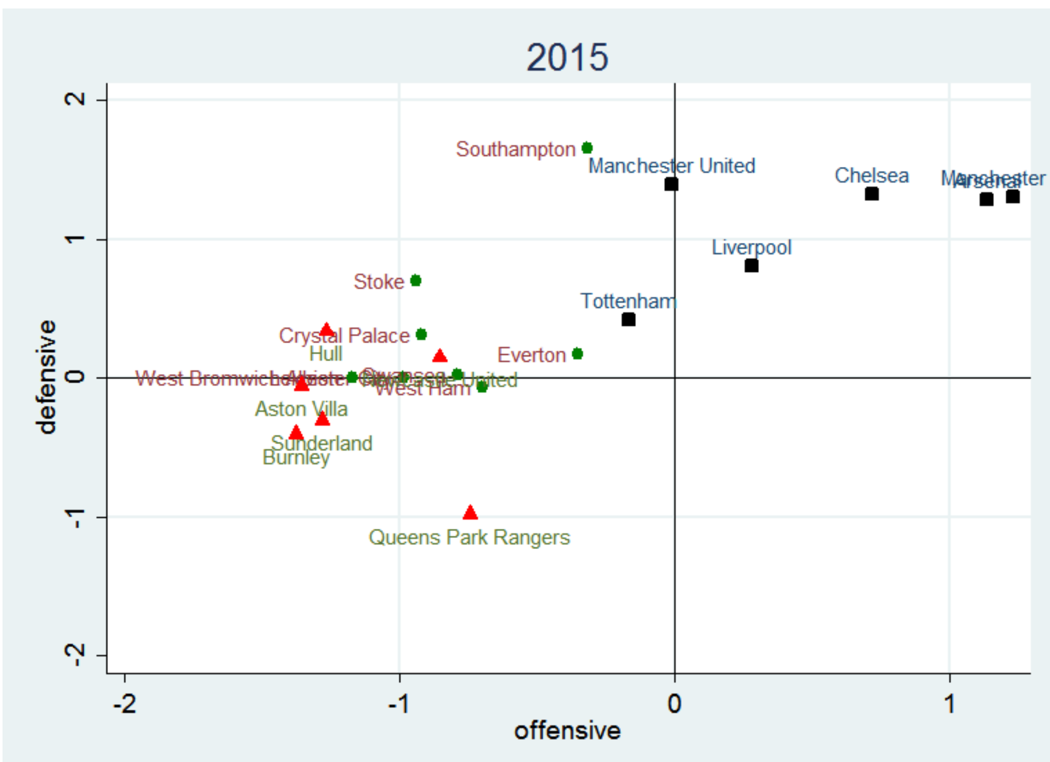
2015
Southampton
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Stoke
Tottenham
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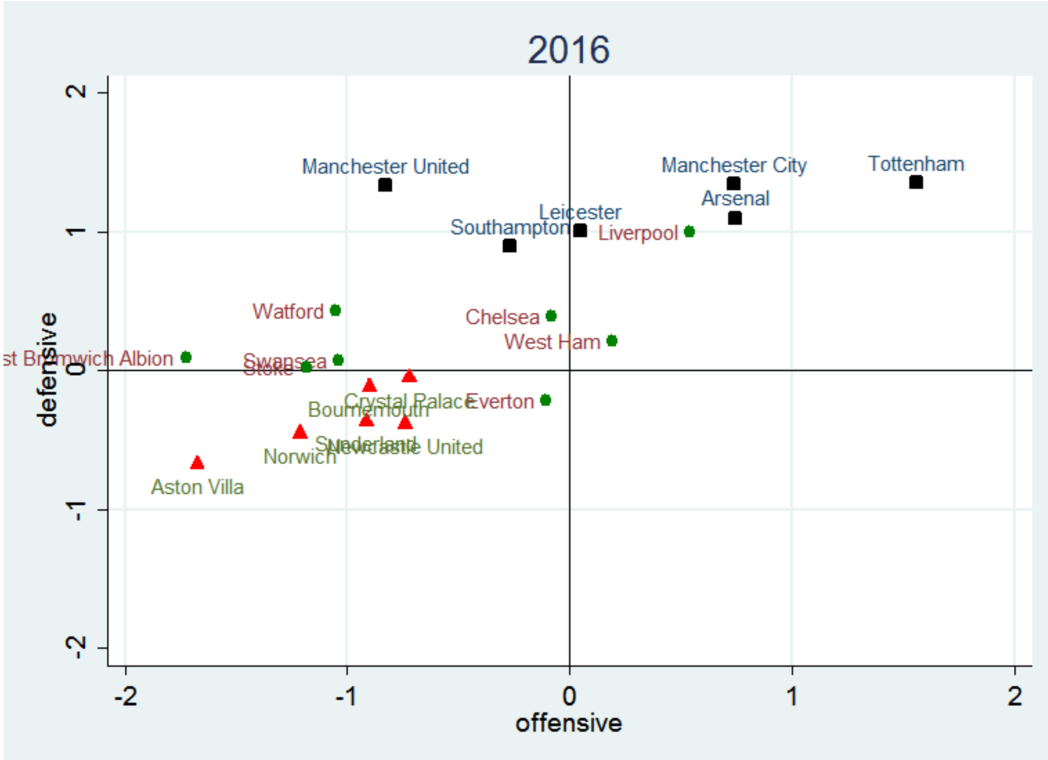
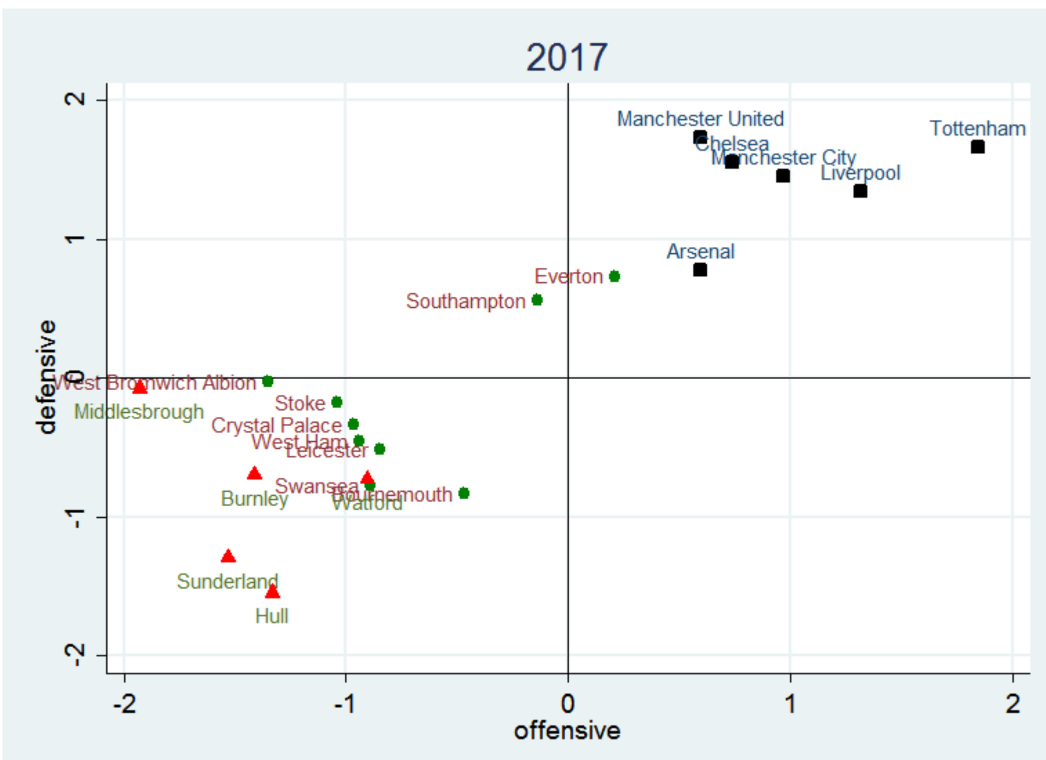

2016
Manchester United
Manchester City
Tottenham
Arsenal
Leicester
Southampton
Liverpool
Watford
Chelsea
West Ham
West Bromwich Albion
Swansea
Stoke
Crystal Palace
Everton
Bournemouth
Sunderland
Newcastle United
Norwich
Aston Villa
defensive
offensive


2017
Manchester United
Tottenham
Chelsea
Manchester City
Liverpool
Arsenal
Everton
Southampton
West Bromwich Albion
Middlesbrough
Stoke
Crystal Palace
West Ham
Leicester
Swansea
Bournemouth
Watford
Burnley
Sunderland
Hull
defensive
offensive